

Report for 2003DE27B: Undergraduate Internship: Influence Of Nitrogen Form On Nickel Accumulation By ALYSSUM MURALE

There are no reported publications resulting from this project.

Report Follows

Undergraduate Internship Project #8 of 10 for FY03

The project is co-sponsored by the *University of Delaware Department of Plant and Soil Sciences (PLSC) and DWRC*. Mr. Glier will explore the effect of nitrogen as an effective and affordable amendment to enhance plant-based cleanup of nickel-contaminated soils.

"I am thrilled to have the opportunity to study the prospective uses of plants in environmental remediation. We have the potential to undercut the costs of more conventional clean-up techniques by millions of dollars by simply planting and maintaining specialized crops on hazardous areas."

-- Justin Glier, University of Delaware undergraduate senior, Environmental Soil Science major.

Abstract:

Unique metal-accumulating plants (i.e. hyperaccumulators) have the ability to absorb, translocate, and compartmentalize excess quantities of heavy metals. These rare plants can be used to extract metals from contaminated sites (i.e. phytoextraction) or to mine metal-rich soils (i.e. phytomining). Due to electrical neutrality requirements, N form has a profound effect on the cation/ anion balance in plants and controls rhizosphere acidification/ alkalization. Ammonium sulfate fertilizers are often used to promote rhizosphere acidification for enhanced phytoextraction. However, several researchers have recently reported a counter-intuitive "pH effect" on Ni accumulation, where Ni is extracted more efficiently at higher pH than at lower pH. The effect of nitrogen form (i.e. NO_3^- or NH_4^+) on Ni accumulation by *A. murale* was investigated to evaluate the best type of fertilization for phytoextraction. Plants (propagated from vegetative cuttings) were grown in perlite media and exposed to nutrient solution via an ebb and flow method. The modified 1/3-strength Hoagland's solution contained 25 μM Ni and was buffered at pH 6.2 with 2 mM MES. After four weeks exposure, plants were harvested (root and shoot), weighed, dried, digested (EPA 3050 B), and analyzed for total metal content (and nutrients) by ICP. Alyssum plants supplied with NO_3^- had 3-fold greater biomass and more than a 3-fold higher Ni concentration than did plants treated with NH_4^+ . Nitrogen form did not alter the translocation factor (~ 2.5) for nickel. Plants supplied with NO_3^- accumulated significantly more Mn, Ca, and Mg than did plants supplied with NH_4^+ , while the latter accumulated more sulfate and phosphate. The results showed nearly a 10-fold difference in Ni extraction in response to available N form, with the NO_3^- treatment providing the greatest uptake. These studies suggest the form of nitrogen could play a significant role in enhancing the ability of hyperaccumulator plants to remove toxic metals from contaminated soils. Better understanding these effects could significantly improve soil and environmental quality.